International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 13, Issue 5, May-2025, Available online at: www.ijaresm.com

Internet of Things Based Automated Smart Snacks Vending Machine with Digital Payment

Mr. Mohan B. S[1], Arpitha M[2], Pallavi M[3], Pooja Mahesh[4]

[1,2,3,4]Dept. of Electrical Engineering, S J B Institute of Technology Bengaluru, India

---

ABSTRACT

The Smart Vending Machine is an advanced automated system that modernizes vending operations through technologies like the Internet of Things (IoT), Bluetooth communication, barcode-based payments, and mobile app integration. Designed for efficiency, security, and user-friendliness, it enhances both customer experience and business operations. Its modular design allows scalability, while multiple rolling product slots ensure smooth and reliable dispensing. A dedicated mobile app provides real-time inventory tracking, remote monitoring, and product availability updates. Bluetooth-based authentication enhances security, while an advanced barcode payment system enables cashless transactions for seamless, flexible payments. The system undergoes rigorous testing to ensure structural integrity, smooth app synchronization, reliable payment processing, and an intuitive user interface. A robust battery backup ensures uninterrupted operation, making it dependable in various environments. By combining smart technology with a user-centric approach, the Smart Vending Machine offers a scalable, cost-effective, and easy-to-maintain solution that meets the rising demand for contactless and cashless transactions. It marks a significant advancement in vending automation, providing businesses with a modern, intelligent alternative to conventional machines while improving efficiency, adaptability, and customer engagement.

Keywords — Automation, IoT, QR-Based Payments, Smart Vending Machine

INTRODUCTION

The rapid advancement of technology has revolutionized various industries, with automation and digitalization becoming integral to improving efficiency and user experience. Vending machines, once simple mechanical devices for dispensing snacks and beverages, have evolved into intelligent systems capable of adapting to modern consumer needs. The Smart Vending Machine is a groundbreaking solution that integrates cutting-edge technologies to redefine traditional vending systems.

Modern vending machines now integrate advanced features like touchscreens, mobile apps, and IoT-enabled systems that allow for real-time monitoring and updates on product inventory, machine performance, and customer interactions. These smart systems can provide valuable insights into consumer behavior, allowing businesses to make data-driven decisions to optimize their offerings. Cashless payment options, such as QR codes and NFC technology, have made transactions faster, safer, and more convenient, eliminating the need for physical cash and reducing the risk of theft.

Furthermore, innovations like energy-efficient designs and the use of renewable energy sources, such as solar power, have helped reduce the environmental impact of vending machines. With the ability to track product demand and automatically reorder items, ensures that shelves are consistently stocked, improving customer satisfaction. Additionally, some machines now offer personalized recommendations and loyalty programs, further enhancing the consumer experience.

The flexibility in payment methods, combined with improved security features, has also made vending machines more accessible and reliable in various settings, from office buildings and airports to hospitals and schools.

As vending machines continue to evolve, they are transforming into self-sufficient, data-driven retail systems that offer more than just convenience—they are becoming an integral part of modern retail and service industries. These advancements are setting the stage for the future of automated retail, where machines not only deliver products but also provide valuable consumer insights and contribute to more sustainable business practices.

PROBLEM STATEMENT

Vending machines have long been an efficient means of providing access to products in a variety of public spaces. However, traditional vending systems face several limitations that hinder their overall functionality and user experience.

International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 13, Issue 5, May-2025, Available online at: www.ijaresm.com

THE MAJOR CHALLENGES INCLUDE

Limited Payment Method.
Most traditional vending machines are designed for cash transactions, which is becoming increasingly outdated in today's digital economy. The lack of support for modern payment options such as mobile wallets or QR codes restricts user access, particularly for those who prefer cashless transactions.

Inefficient Inventory Management
Traditional vending machines do not provide real-time data on inventory levels, making it difficult for operators to track product availability. This often leads to either stockouts or overstocking, both of which negatively affect the consumer experience and operational costs.

Absence of Automation and Confirmation Systems.
Many older machines lack automatic feedback mechanisms to confirm successful product dispensing. This absence of feedback can result in dissatisfaction when customers do not receive their selected items, potentially damaging the brand's reputation.

High Energy Consumption.
Traditional vending machines are typically energy- intensive, consuming significant amounts of power, which is especially problematic in locations with limited or inconsistent power supplies.

Limited User Interactivity and Connectivity.
Conventional systems do not provide an interactive, user- friendly experience. With growing expectations for seamless technology integration, these machines fail to meet the demands of tech-savvy users who desire greater connectivity and personalized experiences.

Challenges with Maintenance and Monitoring.
The lack of real-time system monitoring requires operators to perform manual checks for restocking and maintenance, resulting in inefficiencies and higher operational costs.

OPERATION PRINCIPLE

Objectives
To design and develop an IoT-enabled vending machine system with advanced rolling-slot mechanism of 4 slots to facilitate the precise dispensation of heterogeneous product categories.

To integrated IoT framework to enable dynamic inventory analytics, real-time data synchronization, and remote system diagnostics, fostering a streamlined operational workflow.

Establish a Secured Digital Payment Infrastructure with Bar Code -based transactional platform to support encrypted, contactless, and fail-safe monetary exchanges.

Design an Intelligent Mobile Application conceive and implement a multi-functional mobile application that offers real-time inventory interfacing, Bluetooth- mediated authentication protocols, and seamless user- device interaction.

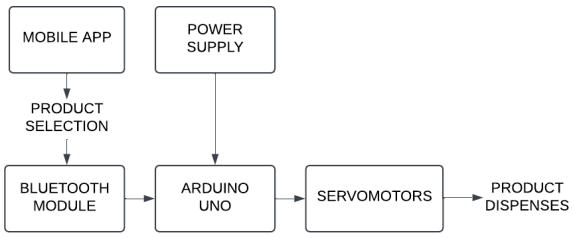

Fig.1: Block Diagram of Smart Vending Machine.

METHODOLOGY

Users browse products through the mobile app, view details like price and availability, complete payment via QR code, and receive a confirmation for product dispensing. After payment, Bluetooth commands are sent to the vending machine to initiate product dispensing, with validation to confirm the transaction.
Products are dispensed through an automated rolling mechanism, assisted by springs for smooth and reliable operation.

Real-time updates on inventory levels are sent to the mobile app, with alerts for low stock, allowing operators to monitor and restock efficiently.

The vending machine operates on a stable power supply via an adapter, ensuring continuous operation without the need for battery monitoring.

The system provides notifications for issues such as failed dispensing, connectivity problems, or payment errors, enabling quick troubleshooting.

The app displays inventory details, supports secure Barcode based payments, tracks transaction history, and allows remote monitoring and management of the vending machine.

Working Principle

The IoT-enabled smart vending machine is an advanced automated retail system that integrates product selection, cashless payment, and dispensing through a mobile application. The system is powered by a regulated power adapter that ensures stable operation of the Arduino UNO, which acts as the central controller.

Communication between the vending machine and the user's smartphone is facilitated through the HC-05 Bluetooth module, allowing seamless data exchange. When the machine is powered on, the Arduino initializes the system and updates real-time inventory data before enabling user interactions.

Users' selection of their desired product via the mobile application, this request is transmitted to the Arduino through Bluetooth communication. The Arduino verifies product availability and prompts the user to proceed with payment. Transactions can be completed via a barcode scan or an in-app payment system, ensuring a cashless and efficient checkout process.

Upon successful payment verification, the system triggers the servo motor-driven dispensing mechanism, which rotates a spring-based system to release the product into the collection tray.

The vending machine features real-time inventory tracking, ensuring that stock levels are updated immediately after a transaction. This data is sent back to the mobile app, providing both the user and vendor with up-to-date information on product availability.

Additionally, the system notifies the vendor of sales trends and stock depletion, facilitating timely restocking and efficient inventory management. The modular design of this smart vending machine allows for future scalability, including the integration of cloud-based monitoring, NFC payments, and AI-driven analytics.

By leveraging automation, real-time connectivity, and intelligent inventory management, the smart vending machine represents a significant step forward in automated retail. As IoT technology continues to evolve, such vending machines will play a crucial role in redefining the consumer shopping experience, ensuring greater efficiency, convenience and reliability for both users and vendors alike

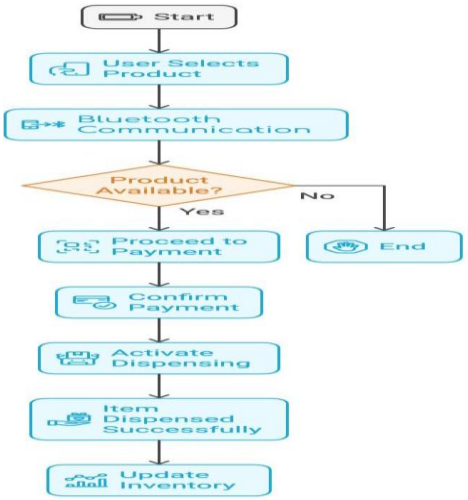

Fig.2: Workflow Diagram of IoT Based Automated Smart Vending Machine.

SYSTEM SETUP AND IMPLEMENTATION

Hardware and Software Components
Arduino UNO (Microcontroller)
Bluetooth Module (HC-05)
Mobile App Interface
Power Supply
Servomotors
Barcode Scanner
Embedded System Programming
Hardware and Software Functionality
Microcontroller (Arduino UNO):
Central controller of the system.
Manages inputs and outputs, handles Bluetooth communication, and executes embedded programming for overall system control.

Bluetooth Module (HC-05):
Enables wireless communication between the vending machine and the mobile app.
Facilitates user authentication, transmits product selection, and processes payment confirmation.

Mobile App Interface:
Serves as the primary interface for users to select products, make Barcode-based payments, and view real-time inventory and transaction history.
Integrates a Barcode scanner for secure and
contactless payment.

Power Supply:
Provides stable power to all components through an external adapter.
Ensures consistent operation of the Arduino UNO,
Bluetooth module, and servo motors.

Servo Motors:
Operate the spring-based dispensing mechanism.
Deliver precise movements to release products into the collection tray, controlled by the Arduino using PWM signals.

Barcode Scanner:
Incorporated in the mobile app for secure payment processing.
Validates transactions and relays confirmation to
the Arduino.

Embedded System Programming:
Written in C/C++ using the Arduino IDE.
Manages system logic, Bluetooth communication, sensor inputs, and product dispensing mechanisms.

Project Implementation
Arduino UNO (Microcontroller)
Power Supply: The Arduino UNO is powered via the Vin pin or 5V pin from an external power adapter.
Bluetooth Module (HC-05): The HC-05 Bluetooth
module is connected to the TX pin (transmit) and RX pin (receive) on the Arduino UNO for serial communication. HC-05 is powered via the 5V pin.
Servo Motor: The servo motor is connected to one of the PWM-enabled pins (e.g., Pin 9) on the Arduino for controlling its rotation. It is powered through the 5V pin.
Barcode Scanner: For mobile app-based Barcode scanning, this is done directly within the app.

Bluetooth Module (HC-05)
VCC: Connects to the 5V pin of the Arduino to power the module.
GND: Connects to the GND pin of the Arduino.
TX (Transmit): Connects to the RX (pin 0) on the Arduino to receive data.
RX (Receive): Connects to the TX (pin 1) on the
Arduino to transmit data.

Mobile App Interface

No direct hardware connection to the system; it communicates wirelessly with the Bluetooth module (HC-05) via Bluetooth.
The app sends product selection and payment data
and receives updates on inventory and status.

Power Supply
The power adapter (external) connects to the Vin pin of the Arduino to supply regulated voltage (e.g., 12V). The Arduino will step it down to the necessary 5V for powering all components.

Servo Motors
Control Pin: The signal wire of the servo motor is connected to a PWM-enabled pin on the Arduino (e.g., Pin 9).
Power Pin: The servo motor's power wire is
connected to the 5V pin on the Arduino.

Barcode Scanner
The mobile app itself scans Barcodes, it only communicates with the Arduino via Bluetooth for payment verification.

Embedded System Programming
Arduino is programmed using the Arduino IDE, where you define the logic for handling communication with the Bluetooth module, servo motor control, inventory updates, and interaction with the mobile app.

Outer Framework
The physical structure of the vending machine comprises a robust plywood framework for stability, with a transparent fiberglass front panel allowing users to view available products.

This design ensures both functionality and visual appeal while maintaining cost efficiency.

Circuit Diagram

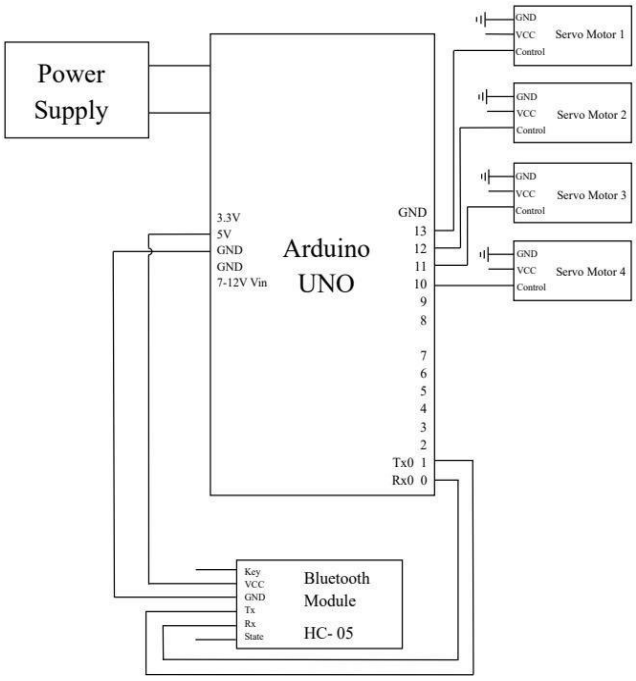

Fig.3: Circuit diagram for IoT based Smart Vending Machine

RESULTS AND DISCUSSIONS

A. Results

The smart vending machine project successfully integrates mobile app-based product selection, payment processing, and automated dispensing. The system operates efficiently, with reliable product dispensing and real-time inventory updates. It is powered by a stable power supply. Bluetooth communication between the app and the vending machine is seamless, ensuring smooth transactions. The project has proven cost-effective, leading to increased product sales, with

low operational and maintenance costs. Future improvements may focus on scalability, enhanced user features, and additional payment options.

B. Discussions

The smart vending machine project presents a significant advancement in automated retail, combining IoT technology, mobile app integration, and real-time inventory management. The system's design ensures ease of use, with users able to select products and make payments through their mobile apps, streamlining the entire transaction process. The integration of the Bluetooth module and servo motor mechanism ensures that products are dispensed accurately and efficiently. The real-time inventory updates and vendor notifications offer a practical solution for maintaining stock levels, which is crucial for efficient vending operations.

Photo Gallery

Fig.4: Working Model of IoT Based Automated Smart Snacks Vending Machine with Digital Payment.

Fig.5: Mobile Application Icon for the Smart Vending Machine.

Fig. 6: Bluetooth Device Connectivity in Mobile App.

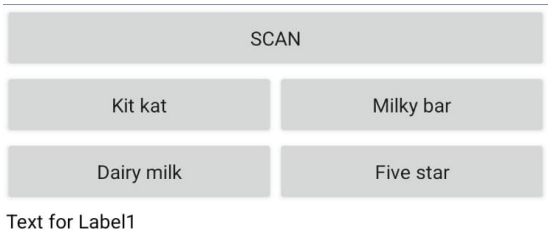

Fig.7: User interface showing buttons for scanning

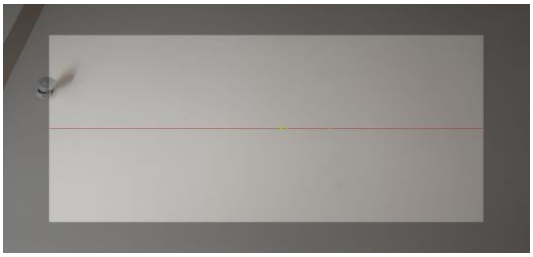

Fig.8: Screen displaying the scanning interface with a red line indicating alignment.

Fig.9: Barcodes of the products for scanning labelled as A (Kit kat), B (Milky bar), C (Dairy milk), and D (Five star).

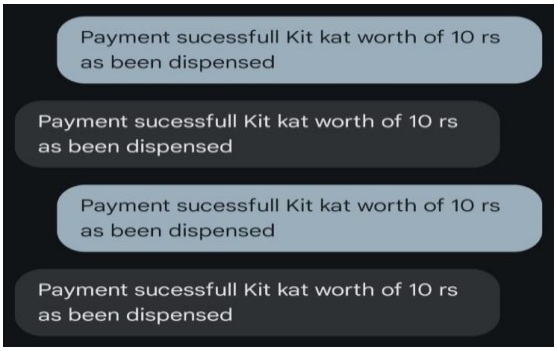
Payment sucessfull Kit kat worth of 10 rs as been dispensed
Payment sucessfull Kit kat worth of 10 rs as been dispensed
Payment sucessfull Kit kat worth of 10 rs as been dispensed
Payment sucessfull Kit kat worth of 10 rs as been dispensed

Fig.10: Messages confirming successful payments for different chocolates via SMS.

CONCLUSION

The smart vending machine project successfully demonstrated the integration of IoT, mobile app interfaces, and real-time inventory management to create an efficient, automated product dispensing system. It provides a seamless user experience with easy product selection, secure payments, and accurate dispensing.

The system's stable power management ensures consistent performance, and real-time inventory updates enhance operational efficiency. While the system has demonstrated success, future enhancements, such as scalability, additional payment options, and improved user features, could further optimize its capabilities. This technology can be integrated to public spaces, office buildings, shopping malls, and specialized environments like healthcare facilities, offering a

variety of products with the convenience of automated, contactless transactions. This project showcases the potential of IoT-driven vending solutions to transform the traditional retail landscape by improving convenience, cost-effectiveness, and efficiency.

REFERENCES

[1]. S. Thete, A. Titare, S. Vanikar, and G. Madhikar, "Smart vending machine system using IoT," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 11, no. 1, Jan. 2024.
[2]. W. Alam, D. Sarma, R. J. Chakma, M. J. Alam, and S. Hossain, "Internet of Things based smart vending machine using digital payment system," *Indones. J. Electr. Eng. Inform.*, vol. 9, no. 3, Sep. 2021.
[3]. G. Nemoto and K. Hiraishi, "Modeling and optimization of item changes in vending machines," in *Proc. Asian Control Conf.*, 2020, pp. 19–24.
[4]. Sooraj, B. Mons, and J. Kuruvilla, "IoT based vending machine with cashless payment," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 6, no. 6, June 2019.
[5]. D. T. Wiyanti and M. N. Alim, "Automated vending machine with IoT infrastructure for smart factory application," *J. Phys.: Conf. Ser.*, vol. 1567, 6th Int. Conf. Math., Sci. Educ. (ICMSE), Oct. 2019.
[6]. A. Ramzan, S. Rehman, and A. Perwaiz, "RFID technology: Beyond cash-based methods in vending machine," in *Proc. 2nd Int. Conf. Control Robot. Eng.*, Apr. 2017.